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The American Biology Teacher

VOL. 5 MAY, 1943 NO. 8

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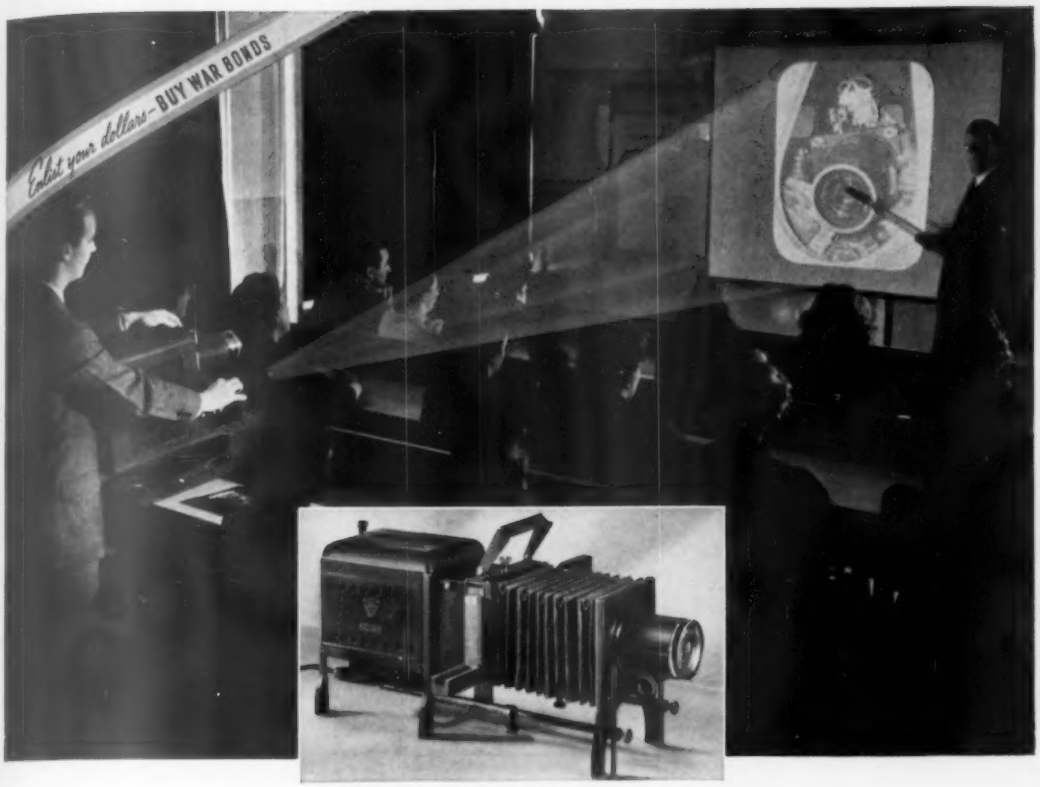

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The American Biology Teacher

Vol. 5 MAY, 1943 No. 8

The Natural History Background of Camouflage*

HERBERT FRIEDMANN
Curator, Division of Birds, U. S. National Museum

If we look up the word "camouflage" in a standard dictionary, we find it defined as concealment by disguise. The disguise may be of such a nature as actually to simulate the immediate background or merely to break up the outline or reduce the visible solidity of the object camouflaged. When man tries to camouflage an object, he is literally disguising it; in nature, on the other hand, the "disguise" is the normal coloration and is so termed because it has the effect, without effort, that man consciously aims for in his attempts.

The essential elements involved in camouflage are those of concealment and surprise. Most wild creatures live in constant danger from enemies or are themselves ever on the alert for prospective prey. They do not know the comparative security and peace of our peacetime civilized lives. It is, therefore, not surprising to find animals of all sorts exhibiting countless types and degrees and variations of such concealing adaptations as are implied by the term "camouflage."

During the last war camouflage was developed extensively along such lines as dazzle-painting of ships to break up their mass and render their outlines less definite and less recognizable, splotch-painting of field artillery pieces to simulate their surroundings, and lightening those parts of objects that were usually in the shadow to reduce the visual solidity of the objects involved. On the whole, it may be said that the bulk of the camouflage work was done to create concealment from ground level or at least from fairly low levels. However, with the present enormous development in aerial warfare the problem of effective camouflage has come to resolve itself more into concealment at a distance or from a height than from nearby. Military camouflage is necessarily a secret of

* Condensed from the author's article of the same title, Publication 3700 of the Smithsonian Institution, *War Background Studies Number Five*, Washington, D. C., December, 1942.

the armed forces, but the natural-history basis of all this work may here be outlined for the interested reader.

The modern study of concealment and disguise in nature may be said to date from the work of the American artist-naturalist Abbott H. Thayer. His first paper, originally published in an ornithological journal, *The Auk*, in 1896, was given wide distribution the following year in the annual report of the Smithsonian Institution. In 1909 Thayer brought together in definitive form his discoveries, ideas, and observations in a stimulating book entitled, "*Concealing Coloration in the Animal Kingdom*," which has served as a basis for all subsequent work and which is still useful and interesting in spite of subsequent data.

As Thayer first pointed out, we must remember that it is at the crucial moments when animals are on the verge of catching or of being caught that sight is commonly their indispensable sense. Smell and hearing may lead an animal toward its prey or away from its enemy, but in the last all-important seconds, sight is relied on almost entirely in many animals. It should be stressed at the outset that not all animals are concealingly colored, but this does not affect the interest in, and suggestive value of, those cases where they are.

FIG. 1. Nighthawk, adult, young, and eggs.

FIG. 2. Spotted sandpiper, young and eggs. (From exhibits in the U. S. National Museum.)

OBLITERATIVE SHADING

The immediate surroundings in which animals are found are naturally very variable in such matters as vegetation, amount of light, type of earth (whether rocks, gravel, sand or bare earth are visible, or if everything is covered by leafage), and consequently the patterns needed for effective concealment are equally diverse. There is, however, one underlying factor common to animals in all of these backgrounds to a greater or lesser extent. It is this: Regardless of its particular color pattern, to become relatively invisible an animal must lose its appearance of solidity, or, to put it in other words, must not apparently cast a shadow on itself. The light falling on an animal usually comes from one direction, generally from above, so that some parts of the animal (usually its back) are in stronger light and the opposite parts (usually the underside) are in dimmer light or even in the shadow of the illuminated parts and tend to look darker. This is easily seen by placing a white ball on a table with the light coming from above—the under surface of the ball is shaded and at once reveals the spherical solidity of the ball, even though it be placed on a white table. In most animals the light and dark tones are so arranged that they somewhat counteract the effect of self-shadowing. This is brought about by having the darker tones where the light strikes (usually from above) and the paler tones on the parts in shadow (usually the lower parts). This distribution of light and dark tones on the animal, tending to counterbalance the unequal lighting the

parts receive, is known as obliterative shading or countershading.

Many and quite unrelated groups of animals—mammals, birds, reptiles, fishes, etc.—in all parts of the world show it. Countershading may be described in relation to body form, to environment, and to habits. In some caterpillars, the normal resting position is inverted; *i.e.*, the back is down and the belly up (example, the larva of the eyed hawk-moth, *Smerinthus ocellatus*), and it is indeed suggestive that in these creatures the countershading is reversed, being darker on the underparts and paler on the back.

However, the picture is not as simple as it has been presented so far in this paper. In the majority of cases, the immediate background against which even the most perfectly countershaded animal is to become invisible is not an even tone of one color without breaks of any kind. If there is a background of grass, for example, each blade (when close up) has a shadow, or at least an outline; fallen twigs or leaves present even more shapes and irregularities of light and dark.

FIG. 3. Countershading and color resemblance in the sanderling. (Drawn by W. A. Weber.)

FIG. 4. Color resemblance without countershading is not enough. The white-tailed ptarmigan is revealed by its visual solidity and its shadow. (Drawn by W. A. Weber.)

Color Resemblance

Most of us have at one time or another become aware of a general similarity in appearance between certain animals and their surroundings. We have come to expect creatures living in deserts or sandy places to have pale or sandy hues and not to startle us with the brilliant greens and reds of some of the denizens of dense tropical forests. Without asking ourselves why or even consciously wondering, we connect the white of the polar bear and of the snowy owl with the snow and ice of their arctic habitat.

The whole question of color resemblance is still unfortunately largely couched in terms of human color vision. This will have to be altered with increasing knowledge of the color vision of animals. An example may help to clarify this point. It is known that modern developments in infrared photography have revealed that different green animals differ greatly in their absorption of infrared light, and consequently those with great absorptive properties photograph as dark objects and those that reflect (and do not absorb) the infrared come out as light objects in the photographs. It is suspected that some predaceous animals, such as certain owls, have a visual range beyond the human one on the infrared end of the spectrum. It would follow from this that some green animals might be seen readily by the owls while others would not, al-

though to our eyes both would seem equally well concealed by their color. This problem is well known to the military camouflage experts in their experiments in concealing buildings, etc. with green paint or with leafy branches, the paint absorbing the infrared light and the chlorophyll in the leaves reflecting it.

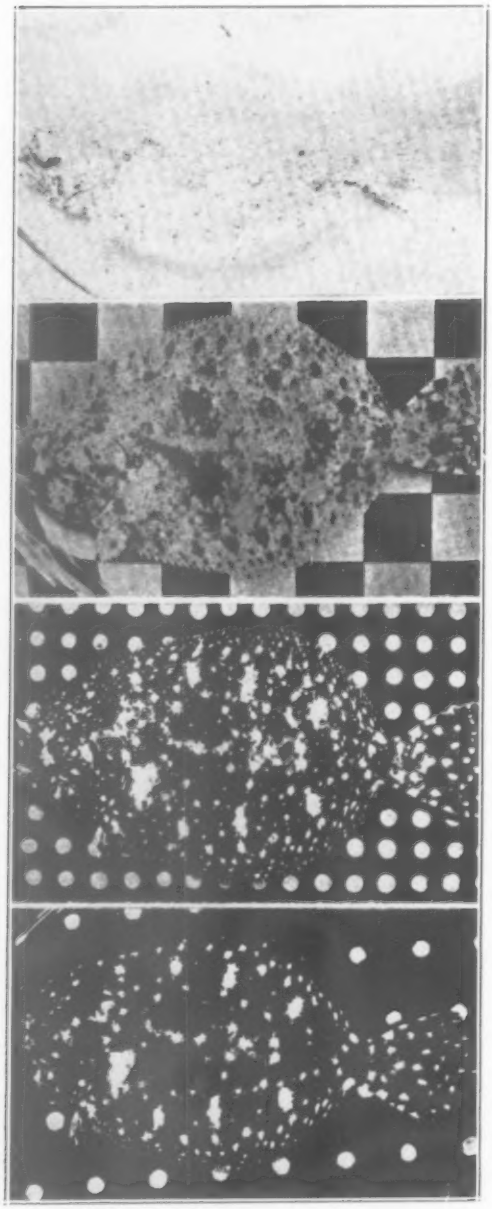

FIG. 5. Change in color and pattern in flounders. Photographs of the same individual fish in an aquarium tank under which different card bottoms were placed. (From Mast, Bull. U. S. Bur. Fisheries, 1941.)

In some animals we find a seasonal change in coloration which appears to be directly correlated with seasonal changes in the background. There are a number of types of color resemblance in animals which are variable and depend on changing environmental conditions. Probably the best known case of rapid change in color is that of the chameleon, a small lizard which in the course of a few minutes can change its color through a surprising range of browns, reds, and greens, and darks and lights. Fishes also possess amazing ability to change their color in keeping with changes in the background against which they find themselves. The flounders, ordinarily grayish brown or grayish olive in color, speckled with darker brown, not only can and do respond to altered backgrounds by changing from pale sandy yellow to dark blackish brown, but even alter the fineness or coarseness of their pattern in keeping with that of the background, simulating to an astonishing degree the texture and pattern of the bottom on which they are resting.

Aside from obliterative shading and color resemblance many animals are still further concealed by the fact that the patterns of their coloration tend to break up their outlines, so that at a distance they seem to be bits of the general surroundings rather than a recognizable shape which would tend to reveal them. This type of marking is known as—

DISRUPTIVE COLORATION

In a general way it may be said that the concealing effect of a disruptive pattern is greater if parts of its included pattern bear a good color resemblance

to the background while other elements are strikingly distinct. The result is that the background seems to be seen through the animal in places, thus breaking up its visual form. Thus, a butterfly with a brown and green pattern would stand out as a butterfly against a background not containing either of these colors, but against a brown ground it would look like an aggregate of green spots, or against a green ground, like a bunch of brown marks. Everyone who has watched ring-necked plovers on the beach is aware of the disruptive effect of the collar at a significantly short distance.

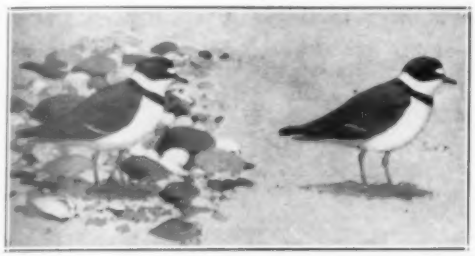

FIG. 6. Effect of disruptive markings in the ring-necked plover. Left—against its normal background; Right—without its background. (Drawn by W. A. Weber.)

CONSTRUCTIVE SHADING

The amount of difference in tone and color of immediately adjacent parts of the pattern has an important bearing not only on the degree of success in its disruptive illusion, but also on the illusory pictorial relief it may create on the animal's surface. For example, if between the darkest and the lightest elements in color pattern there is a gradual change from one to the other, the optical effect is that of a rounded surface (from shade to light); if, however, the darkest and the lightest elements are in immediate juxtaposition the effect produced is one of sharp ridges. Convexities may be made to appear concave, flat surfaces to assume undulations, and curved areas to flatten out, by the relation of adjacent pattern elements. In some instances constructive shading brings about an astonishing similarity to other objects such as the appearance of leaf vein ridges in some caterpillars.

Somewhat akin is another type of disruptive pattern which has the effect of seeming to connect wholly distinct and not even adjacent parts of the body. A good example is the banded pattern in many frogs. When the frog is at rest (and in most cases no camouflage is of use when the creature is moving) the legs are folded close against the body and the bands of the body appear to be continuous with those of both the upper and the lower portions of the leg, optically merging them into one mass. If the bands went in different directions on the legs they would stand out distinctly from the body and attract attention.

CONCEALMENT OF THE SHADOW

As seen in the case of the white ptarmigan against a snowy background (Fig. 4), that aside from the bird's lack of obliterative shading and its consequent visual solidity, its presence is revealed by the shadow it casts on the snow at its feet. In case of danger the shadow would be largely done away with, as the bird would squat low on the snow and actually cover a good part of its shadow. It is actually no exaggeration to say that in many cases of animals with a color pattern more or less concealing in nature, the shadow is more noticeable than is the animal casting it. In animals with dorsoventrally flattened or depressed body form, shadows are often reduced by the animal squatting closely against the ground or branch or whatever the creature is resting on, but in many cases there are structural features which, whatever their other functions

may or may not be, do serve to reduce shadow by covering it from sight. Many reptiles and amphibians, such as the horned toad, have lateral finlike flanges on the tail which not only help to cover the shadow that would otherwise be visible, but by their gradual slope from the top of the tail to the substratum throw little if any shadow beyond themselves.

Disappearing Coloration

All the items examined so far have to do with animals that are more or less stationary. There are also a great many animals that show bright patches or patterns when in motion but suddenly conceal them when alighting. From the standpoint of the pursuer it is very confusing to be chasing something with a bright, vivid telltale mark and then find it suddenly vanishing. It often results in the pursuer racing on beyond the hiding prey and thereby losing all chance of securing it. Color patterns of this disappearing type are of two main kinds, the one depending on the distinctive pattern being actually covered when at rest, the other depending on differential orientation to light. An example of simple disappearing coloration is the common North American woodpecker, the flicker (*Colaptes auratus*). In flight this bird shows a large conspicuous white patch on the rump, and bright golden yellow undersides on the wings and tail. On alighting these parts are immediately concealed, and an enemy following these beacons might well be confused by their sudden extinction. An example of the more elaborate type is the leaf butterfly (*Kallima paralekta*). This insect has a bright orange, brown, and whitish pattern of bold markings on the upper surface of its wings, which make it a conspicuous sight when the creature is flying. On alighting on a twig, however, the wings immediately close together over the back, leaving only their undersides visible. Both in color and in form the closed wings look amazingly like a dried leaf and the insect is suddenly completely concealed, to the bewilderment of its possible pursuer.

The other type of disappearing color is that found in animals with iridescent scales, feathers, etc. A gleaming ruby light, as on the throat of the male ruby-throated hummingbird (*Archilochus colubris*), is suddenly extinguished as the bird, in its darting about, alters its orientation to the sunlight.

Concealing Body Form

Not only are many animals rendered less conspicuous by reason of their coloration, but also in many (and some of the most startling) cases by their form as well.

We have already seen an instance of leaf resemblance in the case of *Kallima*, the leaf butterfly. The ends of the wings are actually shaped like the stems of leaves and the outlines of the closed wings are duplicates of the periphery of leaves. Even more elaborately worked out is the leaf resemblance of not only the whole, but even the parts of such leaf insects as *Chitomiscus* and *Cycloptera*. Aside from the all-important details which make or mar the effectiveness of the disguise, the basic common element in all leaf-resembling creatures is thinness.

Resemblance to bark is one of the commonest types of morphological disguise. Bark-resembling creatures include many moths, beetles, spiders, tree frogs, climbing lizards, and a few birds. In the moths alone, many distinct families have produced instance after instance of bark resemblance.

Closely connected is resemblance to lichen, as lichen is so frequently found on places analogous to tree trunks (from

the standpoint of their inhabitants). Not only do we find the same range of animals in all parts of the world with lichenlike appearances or with strong bark resemblances, but we even find animals using lichen apparently for their concealing properties. For example, the ruby-throated hummingbird (*Archilochus colubris*), the wood-pewee (*Myiochanes virens*) and the blue-gray gnatcatcher (*Polioptila caerulea*) cover the outsides of their nests with lichens, with the result that they are very well concealed.

Also associated with bark resemblance are those cases of twig resemblance, well illustrated by the familiar walking-stick insect. All parts of the body are here modified into slender twiglike pieces, and the joints between them have much of the appearance of plant nodes. Furthermore, the postures struck by the insects are in keeping with the illusion of small twigs. As a matter of fact, the harmony between usual posture (which is not rigidly fixed in most cases) and the illusory form or color resemblance in many of these concealing-colored animals is one of the strongest lines of evidence for the reality of the camouflage. Otherwise, it might well be a purely man-made interpretation, but when creatures seem to act according to this color or form, or to be colored and shaped according to their normal activities, it is difficult not to grant the reality of this correlation.

Conclusion

Camouflage in nature is, then, widespread, both in all parts of the world, and within all groups of animals. It may be brought about by coloration alone, or by any possible degree and type of conbination of color or morphological characters. It may be rigidly fixed or remarkably plastic. Its degree of success in different forms is highly variable, and, as might be expected, the opinions of investigators as to its merits have been equally diverse. In this brief review we have merely pointed out some of the types of camouflage, have given some idea of its complexity, of its multiplicity of methods and approaches, and of the astonishing heights of deceptive efficiency it attains in many cases. Such controversial outgrowths of the subject as mimicry and the theoretical difficulties it entails have been deliberately left out of the present discussion.

Fig. 7. Bark-resembling insects. (From exhibit in the U. S. National Museum.)

Compiling Supplementary Reading Lists

MARY D. ROGICK
College of New Rochelle

Lists of current or recent magazine articles supplementing the daily lesson from a not too interesting text sometimes kindle an interest in a subject which might otherwise remain dull or unappreciated. These reading lists to be most useful should cover those magazines or journals to which the students have easy access,—or which are in school or public libraries. Naturally they may differ for the various schools since some schools have much better libraries than others.

Normally, much of this data (lists of articles in the various fields of science) is contained in or can be found in the several excellent abstracting journals like the *Biological Abstracts*, *Physiological Abstracts*, *Chemical Abstracts*, etc. Unfortunately, these abstracting journals are not available in all libraries. Equally unfortunate is the fact that not too many teachers ever form the habit of using these journals regularly even when they are available in the library. Hence the teachers do not derive all possible benefit from them. However, these abstracting journals cover a large number of technical publications unsuited to the needs of beginners in the biological sciences and frequently even beyond the comprehension of the instructors. Moreover, many of the articles given in these journals are not available to students because of the limited size of school or city libraries. Sometimes also the abstracting journals do not cover some of the smaller or popular magazines or articles of a scientific but popular or semi-popular nature.

Busy instructors, anxious to keep up with current popular literature and publications in the field of biological sciences and to assign such literature as is suitable for student reading find it a task of considerable magnitude. Compiling a bibliography for any subject requires the expenditure of much time at the library doing routine transcribing, sorting, organizing, typing up, etc.,—more time than the average teacher can allot to that duty. It is at this particular stage that students can be of considerable help. If the work is very carefully planned and evenly distributed among the class members much can be accomplished with comparatively little effort by the students. The students can do a considerable amount of "material gathering," some typing perhaps, and even some sorting of articles before the whole is put into reading list form.

Detailed planning on the part of the instructor will insure more satisfactory returns from the students. Suggestions which can be offered to the teacher for initiating such a project are as follows:

1. Compile a "master" list of the suitable periodicals which are in the school library. This list should include the name, volumes, issues or numbers and dates of issues which are to be indexed.

2. Assign to each student in the class one specific issue of the journal to be looked up in the library.

3. Keep a record of which issues were assigned so that what can not be accomplished in one semester may be continued by succeeding classes or during succeeding semesters until the required amount of work has been completed.

4. Provide each student with a mimeographed set of specific, itemized directions as to just how the work should be done, to insure a reasonable degree of uniformity in the finished product.

The directions should specify two items to be handed in: (a), a *Table of Contents* and (b), a small number of index cards. The first should be a single standard-sized sheet of paper ($8\frac{1}{2}'' \times 11''$ perhaps) headed by the name, number, volume and date of the assigned journal and containing below that the authors, article titles and pages for each article in that issue. The second should be index cards or small slips of paper cut to any desired size on which the student records the author, title and pages of the article as well as complete journal data like name, volume, issue, date. Each article should have a separate index card. If the students can be induced to print rather than to use the cursive style of handwriting it will be easier to read their material. Thus, each student will hand in the *Table of Contents* of a specified issue and individual index cards for each article in the journal. As soon as that has been done the instructor will indicate on the "master" list that this particular issue has been completed and will retain this "master" list for subsequent assignments.

If the *Table of Contents* is in good form and satisfactory in all respects it can be filed away in a special loose-leaf notebook labelled CONTENTS OF JOURNALS. If some of the material is not in good shape it may have to be retyped. The instructor will thus have within easy reach a *Table of Contents* for each issue of a recent journal or magazine. This obviates the expenditure of much valuable time because it will not be necessary to spend too many hours or afternoons thumbing through an assortment of journals in the library until suitable articles to assign are found.

The small index cards, each a record of a separate article, can be sorted out immediately or at some future time, according to the subject or any other system that the instructor may wish. Lists can then be made on the various topics or subjects and posted on the bulletin board for supplementary reading. Assignments can be made to various articles on the list.

If the journal is of the type which covers other sciences in addition to biology then copies of the *Table of Contents* or selected index cards could be given to fellow teachers in the other sciences (physics, chemistry, hygiene, general science, etc.). Thus several science teachers in the school may benefit from this work.

So far only the teacher's interest has been considered. However, the student also gains certain benefits from this assignment. First, he comes in contact with some journals to which he perhaps would not have paid any attention of his own volition or without special urging. Next, he learns about the make-up of a journal, the methods used in compiling bibliographies and comes in contact with scientific terms or names which callenge his interest or his curiosity. He must of necessity look through the assigned journal in order to compile his *Table of Contents* or to make out his index cards. In so doing he may become interested enough in some article to read it. This casual interest may in time lead some students into the habit of reading scientific articles for pleasure.

President's Page

With this issue the AMERICAN BIOLOGY TEACHER finishes its fifth year as the Journal of *The National Association of Biology Teachers*. It is fitting that we make a survey as to what has been done and make plans for the future.

The editorial in the March issue, entitled *The Victory Garden*, pointed out one way we can serve on the home front. It is a very important service that should be headed by some one in each community, probably by the biology or agricultural teacher. The Delaware Valley Club had an excellent Victory Garden Program for their Spring Meeting in Philadelphia.

Those young men and young women, members of our Association, in the War service are making observations that we would like to hear about. If any of you can find time to write about them we would all like to hear from you. What of biological interest are you observing in North Africa, Australia, Iceland, England, Guadalcanal, the Solomons? Are you getting jobs that call into use your biological knowledge—or does the army seem to think that unimportant?

Many biology teachers are employed during the summer in camps all over our country. They will have a grand opportunity to give practical nature study work of the kind suggested by Dr. E. L. Palmer in his article *The War Hits Succotash Biology* published in the January issue. High school boys are now faced with the probability of serving in the armed forces. If they can be taught and given practice in what to do when they are "on their own" in a wilderness, the problem of lack of interest and discipline will vanish.

Have we revised our courses in biology to meet war needs? Various suggestions offered along that line are found in our Journal. The December issue outlined the course of War Biology in Highland Park and carried an article by J. W. Galbreath of East St. Louis, Illinois, giving a suggested list of principles for biology. Dr. C. E. Altenburg of Highland Park, Michigan, is now working on a course in Laboratory Technique, including bacteriology, blood tests, food tests, etc., to be an elective subject with a year of biology as a prerequisite. New York City schools are also starting such courses. The current issue has a contribution to War Biology, on page 184.

Any suggestions as to Journal content or ways in which our *Association* can benefit the cause of biology, or biology teachers will be very welcome and promptly acknowledged. As I supervise Victory Gardens in Highland Park during the summer with my office in Recreation Building, mail directed to 10 Pitkin Avenue, Highland Park, from June 20 to August 20, will receive prompt attention.

Au revoir until October.

DELAWARE VALLEY BIOLOGY CLUB

The spring meeting of THE DELAWARE VALLEY BIOLOGY CLUB was held in the Academy of Natural Sciences Lecture Hall, Philadelphia, March 23, 1943. The meeting was in charge of Mr. B. Bartram Cadbury, President. The following program was presented:

AFTERNOON—4:30 P. M.

Management of Lawns in Wartime—Walter S. Lapp, Northeast High School.

General Discussion: What wartime developments in Biology can we introduce in our teaching? Led by J. S. Welchons, Cheltenham High School.

Business meeting.

EVENING—8 P. M.

Planning and Planting a Victory Garden—John A. Andrew, Jr., The Ambler School of Horticulture.

THE CHICAGO MEETING

Representative Assembly

The special meeting of the Representative Assembly of *The National Association of Biology Teachers* convened at The College Club, Chicago, Illinois, April 24, 1943, at 9:30 A. M. In opening the session President Russell explained that this was in effect the 1942 business meeting of the Association, consequent to the cancellation of the regular meeting. Due to the unavoidable absence of Secretary-Treasurer P. K. Houdek, the president appointed William Katz as secretary pro-tem.

The report of the secretary-treasurer, read by Mr. Russell, revealed a drop of approximately 400 in membership. What percentage of this is due to members entering the armed forces is not known.

Managing Editor Chas. B. Price reported on the bookkeeping procedure and the advertising records. He summarized the sales of advertising space in the journal for the period October–May, 1941–1942 as $1007.17; for October–May, 1942–1943 as $915.15.

As chairman of the membership committee, Mr. Homer A. Stephens described the progress made thus far. Various plans for the stimulation of membership increase were discussed, among them the distribution of advertising posters to teacher training schools and the insertion of announcements in the bulletins of biological supply houses.

The proposed amendments announced in the January and February issues of the journal (pp. 95, 112) were presented for consideration, discussed and voted upon. All of them were passed. The full text of the amended portions of the constitution and by-laws will be printed in the October issue of The American Biology Teacher.

Pursuant to the new Article II, Section 6 of the by-laws, the motion was made and passed that the present officers hold over for one more year.

Recess was declared at 12 noon, and the meeting resumed at 2 P. M. The following motions were discussed and passed:

1. That the president appoint a committee to investigate ways and means of better teaching of conservation.

2. That the appointment of a committee for the development of a common-name system of nomenclature be tabled until a later date.

3. That the officers of the Association consider means of bringing to the attention of the military authorities the value of biology training and how trained biologists may aid the war effort, and that further suggestions and activities be sought from biology teachers generally.

A proposal set forth in a letter from Dr. E. Laurence Palmer that the content of the journal be modified so as to have greater value to elementary science teachers was referred to the editorial board.

Editorial Board

The Editorial Board was called to order at 3:30 P. M. for a report of the editor-in-chief, and for discussion of problems related to the publication of the journal. The following topics were considered:

1. Size of journal. As an economy measure and as a part of the national paper-saving program, the number of pages was reduced from 248 in Volume 4 to 192 in Volume 5 (exclusive of covers). This represents a reduction of 20% in pages; the loss in space was offset to a considerable extent by the use of more fine print.

2. Special issues. These are to be continued, with plans started for an issue on School Gardening. It was decided not to publish a special issue on the role of biology in the war, but instead to print such articles at the first opportunity.

3. Questionnaire sent to editors and officers. The results of a questionnaire sent to all associate editors and officers were discussed.

4. Reprinting of articles. It is not possible to reprint all articles asked for by readers; sometimes the author or the publisher of the original is unwilling to give permission, or the demand may be very limited. No decision was reached on this problem.

5. Editorial policy on content and form. Except for very minor and obvious slips, manuscripts are returned to the authors for suggested changes thought wise by the editors. It is hoped that such returns are not interpreted by the authors as disapproval, but rather as evidence of the editors' interest in the work. Opinion among the associate editors and officers was divided on the question of whether editorial policy is too strict or too lax.

6. Manuscripts. There has been a slight falling off in the number of manuscripts submitted. An increase in the number would give the editors more opportunity for selection and would also give more time for consultation between editor and author.

7. Illustrations. The need for more illustrations and the need for economy can be reconciled by printing only the significant parts of pictures and by reducing the total size of the illustrations. Authors frequently submit pictures that will not make suitable engravings for reproduction.

(Continued on page 189)

Opportunities for Students of Biology in the Federal Civil Service

INFORMATION AND RECRUITING DIVISION*
United States Civil Service Commission, Washington, D. C.

In the Government service today, personnel and equipment are being concentrated on war-connected activities. Some of them are new—set in motion to perform certain specific tasks that had not been performed at all before the United States was at war. Others are activities which, in their fundamental components, are not new, but are invested with new purposes. In the latter category one finds many of the functions performed by today's civil-service biologists. Although occasional demand still exists for the wildlife biologist of the past, the spotlight today is on the biologist in specialized fields.

Especially important at the present time are the duties of civil-service entomologists and parasitologists who, working in laboratories and in army camps, fight the spread of war-induced disease and death. Equally related to the war program is the work of the bacteriologist in foods, whose current concern is with problems arising out of the food needs of our armed forces and our allies.

Present civil-service demand for these specialized biologists exceeds the number of applicants.

Students who have completed one unit of high-school study in biology, or in certain other sciences, may participate in the current examination for Trainee, Scientific and Technical Aid. This is a written examination, and is designed to measure the applicant's aptitude for learning. Trainees learn to do simple mechanical or scientific work in laboratories and receive $1440 a year, plus overtime. Women 18 years of age and over (those living in or near Washington, D. C., may be 16) are needed for these positions. Applications may be obtained at any first- or second-class post office, or from the United States Civil Service Commission, Washington, D. C.

Except for the above-mentioned trainees, the Civil Service Commission is recruiting biologists, not by formal announcement of examinations, but simply by distributing application forms to interested persons. The application form, when returned to the Civil Service Commission, constitutes application for employment. It is rated by the Civil Service Commission examiners according to the extent and quality of the applicant's training, education, and experience. No specific minimum requirements exist. Applicants who are appointed receive "war service appointments" unless their appointments are otherwise specifically limited, they serve for the duration of the war and not more than six months thereafter. They do not acquire classified (competitive) civil-service status, but they have transfer and promotion rights.

* This article was compiled by The Information and Recruiting Division, United States Civil Service Commission. The manuscript was submitted by C. C. Hathaway, as noted in the April issue.

Conjecture as to what positions will be open to students of biology in the post-war civil service must necessarily be based on opportunities which have existed in the past and which may reasonably be expected to exist again.

The Civil Service Commission has announced several examinations for biologists, in recent years, to fill various types of positions in the Department of Agriculture. These include: Assistant and Junior Microanalyst; Biologist (Wildlife); Biologist (Wildlife Research); Biologist (Wildlife Management), Junior Biologist (Injurious Mammals); Senior Biological Aide (Injurious Mammals); Assistant Leader (Predatory Animal Control).

The Department of the Interior employs various types of aquatic biologists, wildlife biologists, assistant biological aids, and refuge aids and managers.

To qualify for most of these positions in the Department of Agriculture and in the Department of the Interior, the completion of four years of college with major work in biology was necessary. Many of the positions required more specialized knowledge. For example, microanalysts, whose work consists of performing microscopic examinations of food and drugs, needed courses in plant morphology and plant histology. Helpful in meeting the requirements of a great many of the other civil-service biologist examinations were courses in zoology, biochemistry, physiology, parasitology, and ecology.

The most recent assembled (written) examination to be held in the field of biology other than the one for the trainees was announced last September. It was for the position of Refuge Aid, at a salary of $1,440 a year. Applicants for this examination were required either to have completed three years of college or university study, including not less than six semester hours in game management or wildlife conservation, or to have had three years of experience in this field. Any combination of such experience and education, totaling three years, was acceptable. Only able-bodied persons in sound physical health and capable of enduring physical hardship were appointed. Conducting range surveys, wildlife population estimates, marsh and aquatic plantings, seed collections, and making cover type maps, are among the duties of the job.

An unassembled examination for the position of Refuge Manager was also announced in September. Applicants for Junior Refuge Manager, a position paying $2,000 a year, were required to have completed a 4-year college course with a major in biology, including at least 12 semester hours in game management or wildlife conservation. Applicants for Assistant Refuge Manager, in addition to completion of four years of college, were required to have had either two years of experience or one year of experience combined with one year of graduate study in game management or wildlife conservation. This position pays $2,600 a year. Again, sound physical health was a requirement. Duties revolve about the management of wildlife refuges and include the maintenance of satisfactory wildlife environment, the regulation of wildlife populations, and the biological improvement of food and cover resources.

Each year, the Civil Service Commission announces an examination for Junior Professional Assistant. These examinations, open to college graduates and college seniors, formerly contained a number of optional subjects. Options have disappeared from the most recent Junior Professional Assistant examina-

tion announcements. The examination is now of a broad, non-specialized nature, and the heaviest demand on the register resulting from the examination is for persons trained in public administration, business administration, economics, economic geography, library science, history, public welfare, statistics, mathematics, and agriculture.

The last old-style announcement for this examination (January, 1942) listed several options in biology and related fields, from which some idea may be gleaned of civil-service opportunities which formerly existed for students of biology, just out of college, without experience. Among them: Junior Biologist (Wildlife); Junior Entomologist; Junior Aquatic Biologist (Physiology); Junior Range Conservationist; Junior Agronomist; Junior Forester; Junior Soil Scientist; Junior Bacteriologist (Foods).

Educational requirements varied with the option. Applicants for the Junior Biologist (Wildlife) option, for instance, were required to have 30 semester hours of college study in biology, including at least 10 semester hours in vertebrate zoology and 6 semester hours in botany, while applicants for the Junior Entomology option needed 20 semester hours in entomology or in entomology and zoology combined.

Soldier vs. Nature

M. BLANCHE COCHRAN
Scott Senior High School, Coatesville, Pennsylvania

Can't we as Biology teachers do something to teach our future soldiers how to get along *with* NATURE? With Nature on their side, many mole hills will not grow to be mountains. Scouts and other campers are living examples of this.

In addition to the *War Biology* course as offered in the December 1942 issue of THE AMERICAN BIOLOGY TEACHER, I would like to include the following:

I. *Foods available from* NATURE *on the various War Fronts*
   A. Plants.
      1. Identification and characteristics.
      2. Habitat.
      3. The part of the plant to be eaten —root, stem, leaf or fruit.

         In New Guinea, for example, the fruits of the banana, coconut, pandanus, wild nuts and berries are edible; roots of the yam and taro; and the stem of the sugar cane are among Nature's most valuable foods.

         In French West Africa, the *Baobab* tree presents a combination of foods: leaves for soup, and the large fruit as a cooked vegetable.
      4. How that part can be prepared out-of-doors by the primitive fireless cooker.

         "A pit is dug in the ground and lined with the leaves of banana and tree ferns. The food to be cooked—yams, including the vines of the plants, taro root, and any meat that may be on hand—is placed on the leaf lining. Rocks that have been heated in a fire nearby are then placed over the food and the ends of the big leaves are drawn over it, so as to seal the contents, and held in place by more hot rocks. In about two

hours the food is thoroughly cooked''.*

5. How such food can be kept for long periods of time, if necessary.

B. Animals.

1. Means of identification.

2. Habitat.

Are they arboreal, land, subterranean, aerial or aquatic? For example, ''all fish in the lowland and coastal waters of New Guinea are edible, except those with parrot-like beaks and those that can bloat themselves with air or water called puffers or porcupine fishes''.*

3. Caution.

The liver of the polar bear is poisonous. No doubt some other animals have parts poisonous to the human digestive system; for these we must be on a constant watch.

4. Method of capture.

5. Preparation to be most tasty and nutritious with meager equipment. (See I–A—4)

II. Natural *enemies most likely to be a menace to our Armed Forces*

A. Plants to be avoided.

1. Poisonous ones, either wholly or in part.

2. Those causing irritations, *e.g.*, ragweed.

3. Disease-causing species.

B. Animals.

1. Examples.

Poisonous snakes, scorpions, gila monsters, black widow spiders, tarantulas, ticks, red ants, mosquitoes, leeches and many others should be given consideration.

2. Enemies commonly found in the daytime.

Some of the first boys to land safely on Guadalcanal were reported to have lost their lives at the expense of the water buffalo because they thought it had the temperament of a Jersey cow.

3. Pests most often found at night.

4. Those which menace the food supply.

5. Disease-carrying and disease-causing types.

C. Extermination.

1. How can the above be controlled or eliminated?

2. How can injury from them be prevented?

D. First Aid, a necessity, has been included in previously suggested programs.

III. Nature *and Camouflage*

An understanding of the word ''camouflage'' in Nature, together with the plant materials at hand, will bring forth many original ideas in class, especially from art students.

American soldiers from Guadalcanal report this camouflage trick of the enemy: ''Jap snipers remove their clothing, paste coconut leaves over their bodies, then tie themselves to a coconut tree with their rifles.'' On occasion men paint their faces in such a way that they best resemble their surroundings.

Somewhere in the mountains of Idaho and Colorado United States paraski troopers are trying out their reversible uniforms. The value of such an outfit was first recognized by strategists when the ski-wise Finns, in white suits to conceal their presence against the snow, played havoc with the Russian lines. The camouflage of guns, munitions and hide-outs to blend with the environment to accomplish surprise and secrecy is being used on all fronts today by both sides.

IV. *Shelter and other protection available from* Nature

Some plant materials when woven together crudely make excellent clothing, mattresses, blankets, crude huts and furniture. For instance, coconut palm fronds furnish thatching for roofs; vines furnish the seats in chair frames; skirts are commonly made from the pandanus leaf and twisted fiber strings. Twisted rattan and woven orchid bark are also common sources of clothing. The common cat-tail holds heat well, so, if available, would be a good filler for fiber bedding.

V. *Drinking Water*

A. Sources.

* Stirling, M. W. *The Native Peoples of New Guinea.* Published by the Smithsonian Institution, Feb. 16, 1943.

B. Means of Purification.
   1. Boil hard for not less than twenty minutes.
   2. Chlorinate by using *Halazone* tablets, two to one quart of ordinary water. Allow to stand thirty minutes before drinking.

We realize such information is available, but from so many scattered sources. Surely War Bulletins with this vital material will soon be forthcoming. Until then, we should attempt first, to get acquainted with the climatic conditions of each war zone; then to study the flora and fauna of each particular climate. For instance, take Northern Africa, a desert tropical region—what natural vegetation and animal life would you except to find in such a place? Having gotten this information, the next step would be to find reliable material on these types of living things; at least the material necessary to successfully teach the above units. Our pupils' curiosity and interest, and current newspaper articles will suggest other important phases of the work in these units, which I have not included.

Nature Trail

CARSTEN AHRENS*
Fifth Avenue High School, Pittsburgh, Pennsylvania

Every city park, every high school campus, every summer camp, whether it is for boy scouts, camp fire girls, or for adults, should have a path along which the trees, shrubs, and wild flowers are plainly, accurately, and interestingly labeled. Such a path can be a constant source of education and entertainment. If you are going to be a camp councilor this summer, plan to construct a nature trail. Even though your knowledge of botany may be slight, there are so many splendidly illustrated tree and flower guides available today, that with the aid of several interested "scouts" the work will become a game.

The Trail Itself

A trail that has no use other than instruction is best, but one of the lesser paths of the camp may be utilized. The path should be just long enough to skirt every possible habitat that the area contains. It should lead through a bog, climb a hill, ford a stream, cross a meadow, etc. In other words, it should visit the highest, lowest, wettest, dryest, richest, and poorest places in the area because different species of plants will be found growing in each. No trail will naturally include all the plants of the region, but the few that are growing elsewhere can be transplanted to the side of the path.

Marking

Small rectangles or squares of tin or wood that have been painted white can be used for labeling. The plant information is neatly printed in India ink since it is water-proof. These metal or wooden tags can be tacked to the species named, or wired if both sides contain information. In case of flowers or small plants, a wood stake or a heavy wire is forced into the earth near the plant, and the tag attached to this. On the label

* For a number of years Mr. Ahrens has spent his summers as a National Park Ranger, in Acadia and Yosemite National Parks.

should be printed: 1. common name (if any), 2. scientific name (genus and species), 3. some fact about the plant that will aid the memory.

Here are some examples:

BOX ELDER
Acer negundo
The only maple that has compound leaves.

RED BUD
Cercis canadensis
This shrub's small red blossoms shine before its heart-shaped leaves make their appearance. It is a member of the bean family; its seeds are encased in a pod.

INDIAN PIPE
Monotropa uniflora
This pale leafless and shade-loving plant cannot manufacture its own food, but lives on decaying wood. It belongs to a group of similar plants known as saprophytes.

Everytime a nature trail is planned, someone asks, "Why include scientific names?" I never argue, just suggest that room be left on the label for the scientific term should it be wished later. In time there may be perplexity over the common name which is often different even in adjoining counties. Sometimes the plant is rare and has never been given a common name. There are many species of willow and hawthorne which are not distinguished in ordinary parlance beyond these terms. Invariably the scientific appellation which holds everywhere is included on the tag.

Often several common names are listed. For instance, the basswood tree is also called limewood, white-wood and American linden. Odd local names are often amusing.

Label the same species several times along the trail. Your scouts will discover that a young tree is often strangely unlike the tree it becomes in twenty years.

The labels should be attached where they can be easily read by one seeking them; yet they should not dangle everywhere, giving a sloppy, price-tag effect. I like a trail so marked that a careless person might travel its entire length and see no tags at all.

SMITHSONIAN INSTITUTION WAR BACKGROUND STUDIES

The Smithsonian Institution is publishing a series of *War Background Studies*, two of which are of particular interest to biology teachers. Study Number Five, published December 11, 1942, is *The Natural-History Background of Camouflage*, a condensation of which comprises the lead article of this issue. Study Number Ten, March 19, 1943, is *Poisonous Reptiles of the World: A Wartime Handbook*, by Doris M. Cochran, Associate Curator of Reptiles and Amphibia, U. S. National Museum. This is a 37-page booklet, with 17 plates, one in color, showing excellent photographic studies of 30 species of snakes and one species of lizard, the Mexican beaded lizard. There are concise descriptions, including colors, size and other distinctive features, of all of the principal dangerously poisonous snakes of the world. The organization plan is geographic, divided as follows: The New World, including separate treatments of The United States and Latin America; The Old World, including Europe and Northern Asia, India and Malaya, Africa, and Australia, New Guinea, and the South Pacific islands. There is a brief selected bibliography and an appendix, the latter including first aid, remarks on antivenin, and directions for making collections.

Books

CULBERTSON, JAMES T. *Medical Parasitology.* Columbia University Press, New York. 285 pp. illus. 1942. $4.25.

The author deals with human parasites and treats principally the following: epidemiology, pathology, diagnosis, treatment and prophylaxis of infections.

There are 21 plates, 16 figures, 7 tables, an appendix, a list of references and an index. The appendix describes techniques and methods of handling parasites and parasitized tissues.

The main contents of the book are divided into two parts. In Part One infection, epidemiology, natural resistance, acquired immunity, diagnosis, specific therapy, and prophylaxis are discussed as they pertain to human parasitology in general. Part Two includes chapters on amoebiases, leishmaniases, trypanosomiases, intestinal flagellate infections, malarias, coccidioses, ciliate infections, trematode infections, cestode infections, nematode infections, insects of medical importance and arachnida, crustacea and myriapoda of medical importance.

The book is not designed to serve as a research aid, as few references to recent research literature are given. Neither is it of special interest to the zoologist, since details of morphology and taxonomy are omitted. However to the biology teacher the book should prove very useful in yielding such practical information as parasitic diseases confronting our fighting forces on the various united fronts; the geographical distribution of human parasites on the continents; and the possibilities of some parasitic diseases being introduced into new yet similar geographic areas of the world following the war. For the medical student a résumé of practical, significant information is stated briefly and in an exceptionally well-organized manner. Theoretical discussion is held to a minimum.

TED F. ANDREWS,
Army Air Forces
Technical Training Command,
Lincoln, Nebraska

Biological Symposia, Vol. IX, *Sex Hormones.* Jaques Cattell Press, Lancaster, Pa. x+146 pp. 1942. $2.50.

Physiological knowledge in the field of endocrinology is developing so rapidly that authoritative, current summaries are of special utility to teachers. The ninth volume of Biological Symposia is devoted to a discussion of certain areas in the field of internal secretions with relation to sex. The eight articles, four of which treat of metabolism and sex hormones, and four which discuss hormonal effects in sex reversals, are presented by unquestionable leaders and pioneers in this highly complicated science. With the exception of the first article by Moore, which is general in nature and serves as an introduction to the three following, the treatment is highly technical. The articles are profitable reading for those only who are specially interested in the effects of the sex hormones.

BROTHER H. CHARLES, F.S.C.,
St. Mary's College,
Winona, Minnesota

Biological Briefs

CARLSON, A. J. *Food and Fitness.* Scientific Monthly 55: 403–407. November, 1942.

There is some doubt that malnutrition exists in as widespread amounts in the United States as some superficial surveys may lead us to believe, but 100,000 fellow citizens do suffer from it. Vitamin deficiency diseases are continuing to decline, and longevity reached a new average in 1941 of 63.42 years. To the extent that we eat foods in as wide variety and natural form as availability and appetite dictate, we can on the whole attain good nutrition. Refining and cooking of foods have caused much of our mineral and vitamin loss. We can obtain enough of these even without milk—a relatively expensive food—without resorting to vitamin pills, "enriched" flours, and other panaceas. The body's iodine needs have been supplied by returning iodine to table salt; it might be beneficial to add calcium, phosphorus, and iron to salt for further mineral supplies. At present, we should work on clearing our food and nutrition education of all fads and selfish commercial propaganda, learn to recognize early stages of malnutrition, and bring nutrition education down to the comprehension and appreciation of the common man.

MCMASTER, PHILIP D. *Lymphatic Participation in Cutaneous Phenomena.* Bulletin of the New York Academy of Medicine 18: 731–767. November, 1942.

Present-day knowledge of the lymphatics shows them to be far more active and abundant than has been heretofore supposed. The flow in the smaller lymphatics is rapid

and can transport foreign materials a considerable distance. The walls of the lymphatic capillaries respond quickly to the normal stimuli of sunlight and warmth and to injuries and mild burns; hence lymph is poured into the region of an injury and its surrounding tissues to carry away noxious products to the lymph nodes even before the blood system begins removing them. Every break in the skin introduces foreign substances directly into the lymphatics, and since it is in the regional lymph nodes that antibodies are first formed against bacteria and viruses these serve as a first line of defense. Injections into the skin are really into the lymphatic system, and immunity conferred by injections and any local reactions are not merely skin reactions but really a generalized activity of the lymphatic system.

CLAIRE, MARY C. *The Story of Blood Transfusions.* School Science and Mathematics 43: 214–220. March, 1943.

One of the most important sequels to Harvey's discovery of blood circulation was what is now called blood transfusion. First applied successfully to animals in 1665, it was very soon used by the physician to Louis XV in saving the life of a boy by a transfusion of lamb's blood. Because of the frequency of failure when subsequently attempted by others, it was banned in 1687 and was forgotten for 150 years. During the nineteenth century investigations were revived and the dangers of infection lessened. Landsteiner isolated the four main blood groups in 1900, and by 1914 sodium citrate was being added to the blood to keep it from clotting before use. In 1929 the *Blood Tranfusion Betterment Association* set up regulations still in force. Whole blood transfusions are still preferred in cases of anemia and carbon monoxide poisoning, but problems of blood typing, transportation, and storage are involved. Therefore whenever possible dried plasma is now being prepared for war use and for other emergencies. It provides all important protein elements for immediate assimilation, raises blood pressure, increases power of coagulation, and stimulates antibody formation. Taken at receiving stations throughout the nation, the *Red Cross Blood Bank* now has 15,000 plasma units on deposit.

HENIUS, FRANK. *Oil from the Amazon.* American Forests 49: 60–62, 91–92. February, 1943.

The Far East formerly supplied us with more than two billion pounds of vegetable oils, for glycerine, soap, drying oils, and other products. Now a vast palm oil storehouse in the Amazon valley awaits tapping. More than half of the Western Hemisphere's 1250 palm species grow in Brazil, but only a few are now commercially utilized. The article lists a number of palms yielding copra, wax, drying and soap-making oils, and fibres. Their commercial development and consequent availability to the United States will depend largely on labor and transportation facilities. In addition, we could use all available imports of castor oil.

LAVRENTIEV, M. *Experimental Medicine in Russia in the War.* Journal of the American Medical Association 21: 436–437. February 6, 1943.

Since the outbreak of the war, the *All Union Institute of Experimental Medicine*, Russia's greatest medical research institute, has decentralized its facilities and has worked on immediate problems related to the war.

(Continued from page 181)

8. Economy. Various plans for reduction of publication costs were discussed, but no action was taken.

9. The editor-in-chief was authorized to make such adjustments to the elementary level as could be done without detracting from the general purpose and aims of the journal.

After a period of discussion of the above topics, it was decided not to make any changes in present policies and methods.

EXECUTIVE BOARD

The Executive Board was called to order at 7:30 P. M. The following action was taken:

1. To appoint Miss Marie Knauz, of Pittsburgh, Pennsylvania, as successor to Mr. Homer A. Stephens as Chairman of the Membership Committee.

2. To take immediate steps in the selection of a secretary-treasurer to replace Mr. P. K. Houdek, who has resigned, to be effective July 1, 1943.

3. To change the membership fee from $1.00 to $1.50 per year.

4. To change the membership application blank to read: "I hereby apply for membership in The National Association of Biology Teachers and enclose $1.50 as my annual membership dues, $1.20 of which is for a year's subscription to The American Biology Teacher."

5. To have a resolution drawn up Messrs. Russell, Stephens and Lichtenwalter, to be presented to Mr. Houdek as an expression of gratitude for his services to the Association and the journal.

WILLIAM KATZ,
Secretary pro-tem.

Recent developments include a prompt method of diagnosing typhus, together with ways of immunizing against the disease and of discouraging attacks by lice. Active phages have been produced against dysentery, pus-forming cocci, and cholera; these may be used in combination with sulfa-therapy. Progress is being made in the study of regeneration of injured nerve tissue, and vitamin B therapy is being used successfully in some phases. Some success has also been attained in the treatment of bone and joint inflammations resulting from large wounds.

RUTH SHERMAN STEIN

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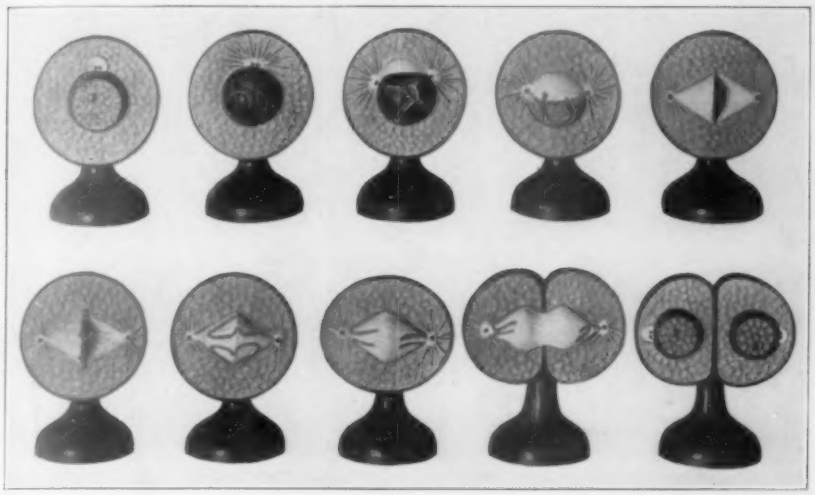

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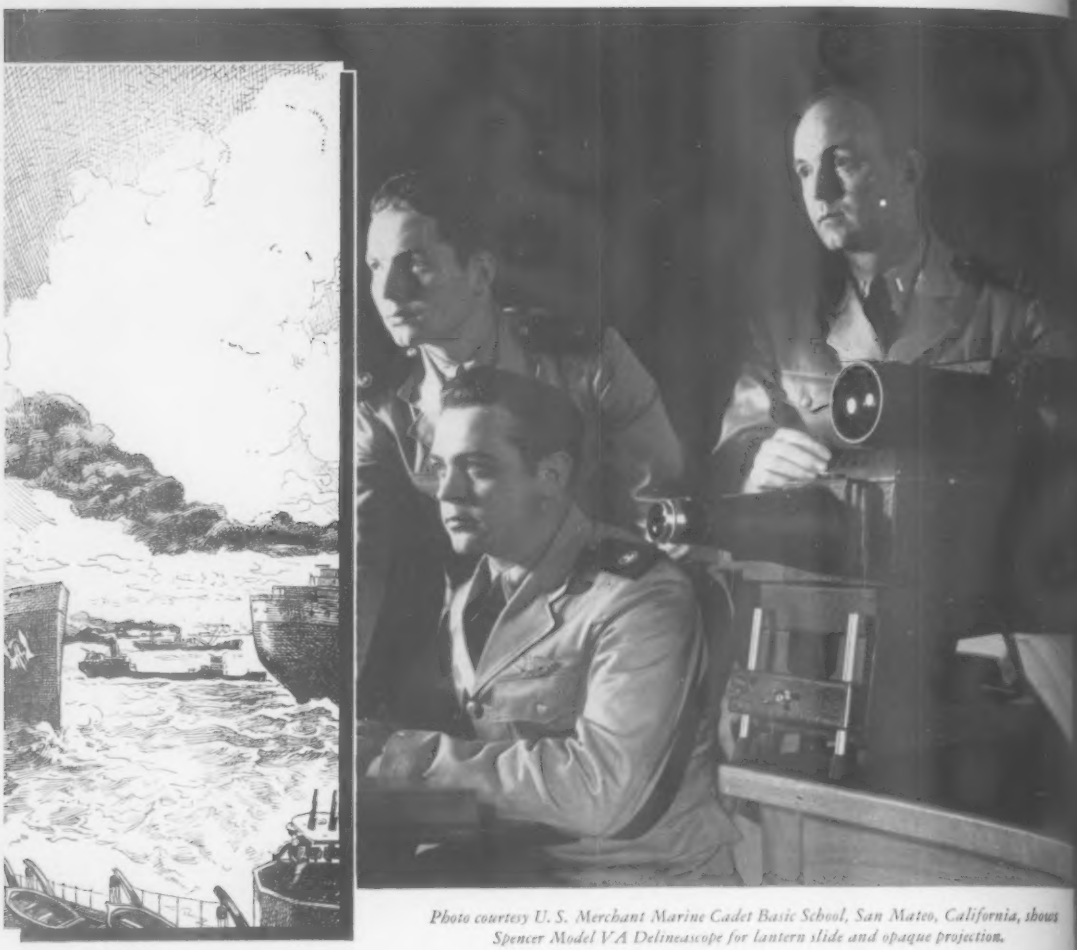

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